MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210)

BMT1014 – MANAGERIAL MATHEMATICS

(All Sections/Groups)

15 FEBRUARY 2023
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **6** printed pages excluding the cover page, with **4** questions only.
2. Attempt **ALL FOUR (4)** questions.
3. Students are allowed to use non-programmable scientific calculators (without restriction).
4. Please write all your answers in the Answer Booklet provided. All necessary workings **MUST** be shown.
5. Mathematical formulas are provided in appendix.

QUESTION 1 [22 marks]

a) Find an equation of a line passing through (2, 1) and perpendicular to the line $y = 3x - 7$. (7 marks)

b) Suppose the variable cost of producing customized shirts is \$4.50 each and the fixed cost is \$100. The customized shirts can be sold for \$7 each.

i) Find the cost, revenue and profit functions. (4 marks)

ii) Compute the cost, revenue and profit for producing 50 customized shirts? (6 marks)

iii) Find the break-even quantity and its revenue. (5 marks)

QUESTION 2 [28 marks]

A local carpenter produces two sizes of handmade wooden products. Each small-sized wooden product takes 10 minutes to design and 20 minutes to assemble. Each large-sized wooden product takes 10 minutes to design and 40 minutes to assemble. The carpenter is able to provide at most 120 minutes per day for designing and at most 360 minutes per day for assembling. The information is summarized as follows:

Task	Small-sized product	Large-sized product	Availability
Design	10 minutes	10 minutes	120 minutes
Assemble	20 minutes	40 minutes	360 minutes

The profit for each small-sized product is RM 25 and for each large-sized product RM 60.

a) Assuming that the carpenter wants to maximize profit, write the linear programming model for this problem. (5 marks)

b) Based on the linear programming model formulated in Q2(a) above, solve the problem graphically, to find the optimal solution. (20 marks)

c) How many units of each wooden product should the carpenter produce to achieve maximum profit? (2 marks)

d) What is the maximum profit the carpenter can gain? (1 mark)

Continued...

QUESTION 3 [25 marks]

a) Compute the simple interest and the accumulated amount for a $520 investment made for 4 years at an interest rate of 7%.

(4 marks)

b) If $13,000 is to be earned in 10 years, how much should be invested into an account that earns 8% interest compounded quarterly?

(5 marks)

c) The Rojas decide to make a $25,000 down payment on a $150,000 home. Compute the monthly payment for a 30-year mortgage if interest charged is 8.4% per year compounded monthly.

(6 marks)

d) Suppose a person deposits RM 730 into a savings account at the end of each month. What is the value of the account after 15 years if the interest rate is 6% compounded monthly?

(5 marks)

e) An aspiring entrepreneur wishes to accumulate RM50,000 in 2 years. How much should he deposit each month into his savings account, which pays interest at the rate of 3.6% per year compounded monthly?

(5 marks)

Continued...

QUESTION 4 [25 marks]

a) Blend Jet manufactures portable blenders. The quantity, x, of portable blenders demanded is related to the wholesale unit price p by the equation

$$p = -3x + 15 \qquad (0 \leq x \leq 1{,}000)$$

The total cost incurred producing x units of blenders is

$$C(x) = 2x^3 - 7x^2 + 8x + 20 \text{ dollars.}$$

i) Find the revenue and profit functions. (4 marks)

ii) Find the marginal revenue, marginal cost and marginal profit functions. (5 marks)

iii) Find the average cost function. (2 marks)

b) Find the first partial derivatives for the function below:

$$f(x, y) = x^2y^2 + 4x^2 - 5y^2 + 3xy + 2x + 7y$$

(8 marks)

c) Evaluate $\int_1^7 (4x^2 - 6x + 7)dx$. (6 marks)

End of questions.

APPENDIX

Summary of Principal Formulas and Terms

1) Linear Equations

(i) Slope of a line, $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

(ii) Point-slope form, $y - y_1 = m(x - x_1)$

(iii) Slope-intercept form, $y = mx + b$ (where m = slope, b = y-intercept)

(iv) General form, $Ax + By + C = 0$

2) Mathematics for Finance

a) Simple Interest

(i) Interest, $I = Prt$

(ii) Accumulated amount, $A = P\,(1 + rt)$

Where P = principal, r = interest rate, t = number of years

b) Compound Interest

(i) Accumulated amount, $A = P(1+i)^n$

(ii) Present value for compound interest, $P = A(1+i)^{-n}$

Where $i = \dfrac{r}{m}$, $n = mt$, and m = number of conversion periods per year

c) Effective Rate of Interest

$$r_{eff} = \left[1 + \frac{r}{m}\right]^m - 1$$

d) Annuities

Notations: $i = \dfrac{r}{m}$ and $n = mt$

(i) Future value of an annuity

$$S = R\left[\frac{(1+i)^n - 1}{i}\right]$$

Where S = future value of ordinary annuity of n payments of R dollars periodic payment

(ii) Present value of an annuity

$$P = R\left[\frac{1-(1+i)^{-n}}{i}\right]$$

Where P = present value of ordinary annuity of n payments of R dollars periodic payment

e) Sinking Fund and Amortization

Notations: $i = \dfrac{r}{m}$ and $n = mt$

(i) Sinking Fund formula	(ii) Amortization formula
$R = \frac{Si}{(1+i)^n - 1}$	$R = \frac{Pi}{1-(1+i)^{-n}}$
Where R = periodic payment required to accumulate S dollars over n periods	Where R = periodic payment on a loan of P dollars to be amortized over n periods

3) Rules of Differentiation

a) Derivative of a constant: If $f(x)$ is a constant, then $f'(x) = 0$

b) Power rule : If $f(x)$ is x^n, then $f'(x) = nx^{n-1}$

c) Constant multiple rule: Derive $cf(x) = cf'(x)$ (c is a constant)

d) Sum rule: Derive $f(x) \pm g(x) = f'(x) \pm g'(x)$

e) Product rule: If $f(x) = u \times v$, then $f'(x) = u\frac{dv}{dx} + v\frac{du}{dx}$

f) Quotient rule: If $f(x) = \frac{u}{v}$, then $f'(x) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{[v]^2}$

g) Chain rule: Derive $g[f(x)] = g'[f(x)]f'(x)$

h) General power rule: $\frac{d}{dx}[f(x)]^n = n[f(x)]^{n-1} f'(x)$

i) Exponential function: $\frac{d}{dx}[e^x] = e^x$

$\frac{d}{dx}(e^u) = e^u[u'(x)]$

j) Logarithmic function: $\frac{d}{dx}[\ln x] = \frac{1}{x}$

$\frac{d}{dx}(\ln u(x)) = \left(\frac{1}{u(x)}\right)[u'(x)]$

4) Integration

a) **Basic Rules of Integration**

(i) Indefinite integral of a constant: $\int k\ du = ku + C$

(ii) Power rule: $\int u^n du = \frac{u^{n+1}}{n+1} + C$

(iii) Constant multiple rule: $\int kf(u)\ du = k\int f(u)\ du$ where k is a constant

(iv) Sum rule: $\int [f(u) \pm g(u)]\ du = \int f(u)du + \int g(u)du$

(v) Exponential function: $\int e^u du = e^u + C$

(vi) Logarithmic function: $\int \left(\frac{1}{u}\right) du = \ln u + C$

b) **Definite Integrals**

(i) **The fundamental Theorem of Calculus**

Let f be continuous on [a,b], then,

$\int_a^b f(x)\,dx = F(b) - F(a)$ where F is any antiderivative of f; that is $F'(x) = f(x)$

(ii) **Area between two curves**

Let f and g be continuous functions such that $f(x) \geq g(x)$ on the interval $[a,b]$. Then the area of the region bounded on $[a,b]$ is given by $\int_a^b [f(x) - g(x)]\,dx$.

5) Calculus of Several Variables

Determining Relative Extrema

$$D(x,y) = f_{xx} f_{yy} - (f_{xy})^2$$

If D > 0 and $f_{xx} > 0$, relative minimum point occurs at critical point (x, y).
If D > 0 and $f_{xx} < 0$, relative maximum point occurs at critical point (x, y).
If D < 0, critical point (x, y) is neither maximum nor minimum.
If D = 0, the test is inconclusive.

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